

WE CLAIM:

1. A modular valve assembly for a power piston in a vacuum booster, the modular valve assembly comprising:
 - 5 an air valve adapted for receiving a push rod;
 - a floating control valve (FCV);
 - an air valve spring;
 - a floating control valve (FCV) spring; and
 - a spring seat operatively attached by a snap connection to the air valve,
 - 10 and retaining the FCV, air valve spring, and FCV spring between the spring seat and the air valve.
2. The modular valve assembly of claim 1, further comprising a floating control valve (FCV) support connected to the floating control valve.
- 15 3. The modular valve assembly of claim 2, wherein the air valve and spring seat are attached directly to one another by a snap connection.
4. The modular air valve assembly of claim 3 wherein:
 - 20 the air valve includes an air valve seat for sealing engagement with the floating control valve, and a first portion of a snap coupling extending from the air valve seat; and
 - the spring seat includes a second portion of a snap coupling extending therefrom adapted for engaging the first portion of the snap coupling, to thereby form the
 - 25 snap connection between the air valve and the spring seat.

5. The modular valve assembly of claim 4 defining an axis of motion thereof, and wherein:

the air valve includes a radially extending flange defining the air valve and
5 the first portion of the snap coupling includes a generally tubular collar extending from the radially extending flange along the axis of motion toward the spring seat, the tubular collar including an outwardly extending catch; and

the spring seat includes a generally tubular collar extending along the axis of motion, the generally tubular collar of the spring seat including an inwardly extending
10 catch adapted for snapping engagement with the outwardly extending catch on the air valve;

the tubular collars on the spring seat and air valve configured for allowing movement of the air valve and spring seat with respect to one another along the axis of motion after the snap connection is made between the air valve and spring retainer.

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6. The modular valve assembly of claim 5 wherein the spring seat includes a flange for retaining the FCV spring between the flange and the FCV, to thereby urge the FCV to move along the axis of motion toward the air valve seat on the air valve.

20 7. The modular valve assembly of claim 6 wherein the flange of the spring seat further retains the air valve spring between the flange and the FCV support, to thereby urge the spring retainer to move along the axis of motion away from the FCV support, and through the snap connection to pull the air valve toward the FCV and FCV support.

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8. The modular valve assembly of claim 7 wherein:
the air valve includes a receptacle therein opening along the axis of motion
for receiving the push rod; and

5 the modular valve assembly further includes a retaining clip in the
receptacle of the air valve for engaging and connecting the push rod to the air valve.

9. The modular valve assembly of claim 8 wherein:
the push rod includes a ball end thereof for engaging the retaining clip;
10 the retaining clip includes a generally spherical portion thereof for
receiving the ball end intersecting a truncated conical portion thereof having a minor
diameter thereof connected to the spherical portion and a major diameter thereof adapted
for receiving the push rod and for snap engagement with the receptacle in the air valve,
the retaining clip further including slots therein for allowing the retaining clip to expand
15 and snap back around the ball end of the push rod and to snap into engagement with the
receptacle.

10. The modular valve assembly of claim 9 wherein the spring seat includes
an axially extending opening for passage therethrough of the push rod without contact
20 between the push rod and the spring seat.

11. The modular valve assembly of claim 2, defining an axis of motion of the
modular valve assembly and further comprising, a push rod extending through the valve
seat, the push rod including a radially extending flange for engaging the spring seat and a
25 ball end thereof for snap engagement with the air valve.

12. The modular valve assembly of claim 11 wherein:
the air valve includes a receptacle therein opening along the axis of motion
for receiving the push rod; and

5 the modular valve assembly further includes a retaining clip in the
receptacle of the air valve for engaging and connecting the push rod to the air valve.

13. The modular valve assembly of claim 12 wherein:
the ball end of the push rod is adapted for engaging the retaining clip; and
10 the retaining clip includes a generally spherical portion thereof for
receiving the ball end intersecting a truncated conical portion thereof having a minor
diameter thereof connected to the spherical portion and a major diameter thereof adapted
for receiving the push rod and for snap engagement with the receptacle in the air valve,
the retaining clip further including slots therein for allowing the retaining clip to expand
15 and snap back around the ball end of the push rod, and to snap into engagement with the
receptacle.

14. The modular valve assembly of claim 11 wherein the spring seat includes
a flange for retaining the FCV spring between the flange and the FCV, to thereby urge the
20 FCV to move along the axis of motion toward the air valve seat on the air valve.

15. The modular valve assembly of claim 14 wherein the flange of the spring
seat further retains the air valve spring between the flange and the FCV support, to
thereby urge the spring retainer to move along the axis of motion away from the FCV
25 support, and through the snap connection to pull the air valve toward the FCV and FCV
support.

16. A method for assembling a vacuum booster, the method comprising:
fabricating a modular valve assembly including, an air valve adapted for
receiving a push rod, a floating control valve (FCV), a floating control valve (FCV)
5 support, an air valve spring, a floating control valve (FCV) spring, and a spring seat
operatively attached by a snap connection to the air valve, with the snap connection
retaining the FCV, FCV support, air valve spring, and FCV spring between the spring
seat and the air valve.
- 10 17. The method of claim 16 further comprising, installing the modular valve
assembly into the vacuum booster, and attaching a push rod to the vacuum booster after
the modular valve assembly is installed in the vacuum booster with a second snap
connection between the push rod and the air valve.
- 15 18. The method of claim 17 further comprising, testing the vacuum booster
prior to installing the push rod.
19. The method of claim 16 wherein the modular valve assembly further
includes a push rod having an end configured for forming a snap connection to the air
20 valve, and a flange adapted for bearing against the spring seat, and the method includes
positioning the air valve, FCV, FCV support, FCV spring, air valve spring, and spring
seat in sequential alignment with one another, inserting the end of the push rod through
the FCV, FCV support, FCV spring, air valve spring, and spring seat, and completing the
snap connection of the end of the push rod with the air valve.
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20. A vacuum booster comprising:
- a power piston; and
- a modular valve assembly installed in the power piston;
- 5 the modular valve assembly including an air valve adapted for receiving a push rod, a floating control valve (FCV), a floating control valve (FCV) support attached to the FCV, an air valve spring, a floating control valve (FCV) spring, and a spring seat operatively attached by a snap connection to the air valve, with the snap connection retaining the FCV, FCV support, air valve spring, and FCV spring between the spring
- 10 seat and the air valve.